Logistics Management Institute

Operational Description of the MCRD-San Diego 3-D Scanner

DL007T3

August 2001

Adam C. Moody

LMI®

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Executive Summary

The Military Services distribute clothing to new recruits through a multi-echelon supply chain. Private-sector manufacturers sell clothing to the Defense Logistics Agency (DLA), which operates a series of wholesale warehouses (although some items are delivered directly to retail from the manufacturer). Recruits at recruit training centers receive their clothing in issue lines at the retail warehouses operated by the Military Services.

For several years, the Marines and the DLA have worked on a series of projects to improve the flow of clothing through the supply chain, reduce inventory, and reduce the number of stockouts and backorders that occur at the recruit training centers. One of these DLA-funded projects has been the development of a 3-D body scanner to replace hand measurement of recruits to determine accurate clothing sizes. With the 3-D scanner ready for prove-out, Marine Corps Recruit Depot - San Diego (MCRD-SD) agreed to field trial the scanner.

Scanner configuration and size are flexible and can vary to match the user's facilities, clothing issuance process, privacy issues, and recruit load. For proper scanning of recruits, the only requirements are the scanner hardware, the computer and software, an operator, and something to block light.

During the field trial, DLA asked LMI to assess the physical set-up and performance of the scanner at MCRD-SD. LMI completed this task during two visits to MCRD-SD in June and August 2000.

During our visits, we observed that the scanner experienced little down time. The scanner's hardware and software remained exceedingly reliable during our three visits. We also observed that the clothing operation staff at MCRD-SD uses the scanner without difficulty. We suggest that scanner use needs to be sufficient to justify cost and produce useful data. To attain maximum value of the scanner, additional uses or users (e.g., night issue, multiple fits of the initial dress clothing issue, periodic scanning of the base's population) other than one fit of dress clothing should be investigated.

The introduction of the scanner into clothing issuance can serve as a catalyst for examining and changing long-standing processes. The scanner presents an opportunity to redesign these processes to better meet the needs of the Service, recruits, and clothing operations.

Contents

FIGURES

TABLES

Chapter 1
Introduction

The Defense Logistics Agency (DLA) tasked LMI to conduct an operational baseline analysis of a proposed three-dimensional (3-D) body scanner at the Marine Corps Recruit Depot in San Diego (MCRD-SD). The findings of this study were presented in the LMI report, *Operational Baseline of the MCRD-San Diego 3-D Scanner Implementation.*[1] Six months later, LMI updated its findings in a second report, *Operational Baseline of the MCRD-San Diego 3-D Scanner Implementation Update.*[2] DLA then asked LMI to the detail the physical set-up, process flow, and performance of the scanner. LMI completed this follow-on task during two visits to MCRD-SD in June and August 2000.

BACKGROUND

The Military Services distribute clothing to new recruits through a multi-echelon supply chain. Private-sector manufacturers sell clothing to the DLA. The DLA operates a series of wholesale warehouses (although some items are delivered directly to retail from the manufacturer). The Military Services—in this case the Marines—operate retail warehouses at recruit training centers. Recruits receive their clothing in issue lines at these retail warehouses.[3]

The Marines operate one recruit training center at Parris Island, South Carolina (MCRD-PI), and another at San Diego, California (MCRD-SD). Each center receives approximately 20,000 recruits per year. Parris Island handles male and female recruits; San Diego handles male recruits only. Each recruit receives about 30 different items of clothing with a total value of about $1,000.

For several years, the Marines and the DLA have worked on a series of projects to improve the flow of clothing through the supply chain, reduce inventory, and reduce the number of stockouts and backorders that occur at the recruit centers. One of these DLA-funded projects has been the development of a 3-D body scanner to replace the hand measurement of recruits. With the 3-D scanner ready for proveout, MCRD-SD agreed to field trial the scanner.

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[1] See Eric L. Gentsch, Adam C. Moody, and Jack J. Vandenberghe, *Operational Baseline of the MCRD-San Diego 3-D Scanner Implementation,* Logistics Management Institute, Report DL007T1, May 2000.

[2] See Adam C. Moody, *Operational Baseline of the MCRD-San Diego 3-D Scanner Implementation Update,* Logistics Management Institute, Report DL007T2, March 2001.

[3] See Eric L. Gentsch and Jack J. Vandenberghe, *Metrics for the Apparel Research Network* (2 volumes), Logistics Management Institute, Reports DL701T1 and DL702T2, August 1997. "Volume 1: The Defense Apparel Business" provides overall measures of cost, quality, and lead-time.

The 3-D scanner uses lasers to form a computer image of the subject's outside body dimensions. With these dimensions, software algorithms predict clothing sizes necessary to fit the individual (e.g., crown, neck, sleeve, chest, waist, and inseam measurements). Traditionally, a civilian employee working for the Marines makes these measurements manually with a measuring tape and records them on paper.

This report details the operation of the scanner at MCRD-SD. Chapter 2 describes the physical set-up and use of the scanner. Chapter 3 discusses the scanner's process times and accuracy rates. Finally, Chapter 4 details LMI's observations and suggestions.

Chapter 2
Scanner Description

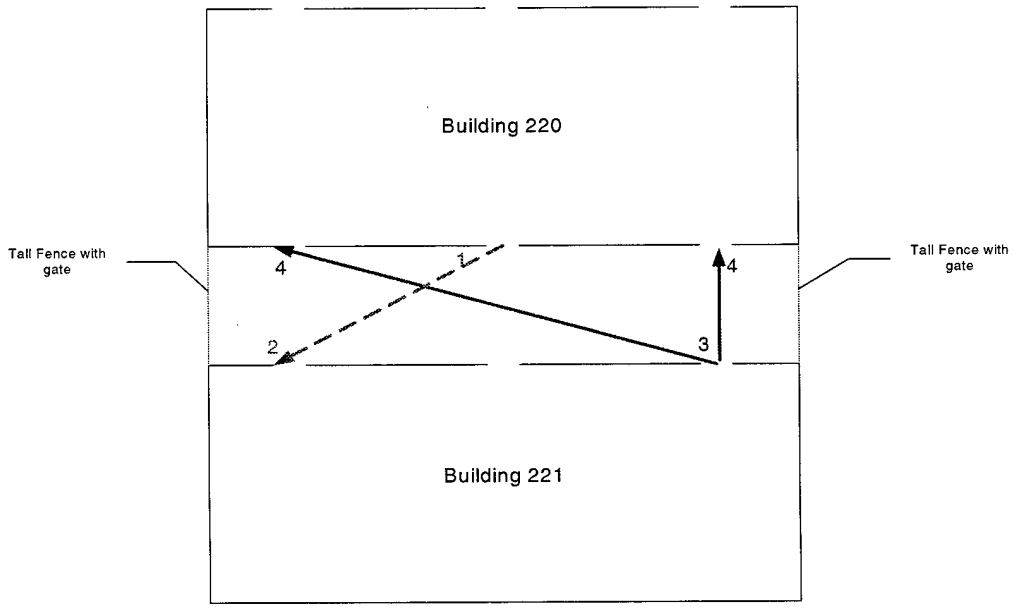
In this chapter, we describe the physical set-up of the scanner, use of the scanner at MCRD-SD, and our observations about the scanner and process.

PHYSICAL SET-UP

MCRD-SD uses the scanner during the first fit of recruit's dress clothing. This first fit occurs in the morning of day 19 or 20 of training. The Marine's clothing operation conducts two first fits a week, on Tuesday and Wednesday mornings. Consequently, the scanner is in use for only 8 to 12 hours a week.

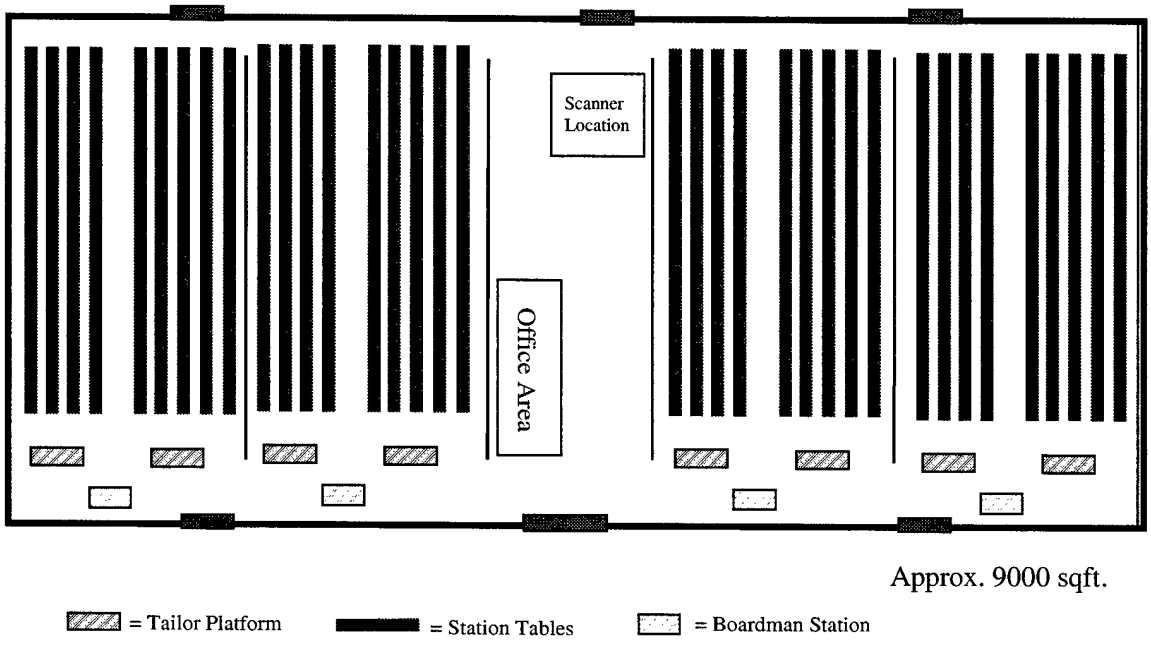
Dress clothing issuance at San Diego occurs in two adjacent buildings. Initial first-fit activities, such as recruit arrival, introductory clothing issuance instructions, brief scanner technology explanations, and recruit scanning occur in the first building, Building 220. The second building, 221, houses the clothing issue line, two fitting stations, and issue line inventory. During first fit, recruits move from Building 220 to Building 221 (arrow 1,2 in Figure 2-1) and return to Building 220 (arrows 3,4 in Figure 2-1) for tailoring. Figure 2-1 illustrates the layout of the operation and the movement of recruits between the two buildings.

Figure 2-1. Clothing Issuance Buildings



The scanner resides in Building 220, as illustrated in Figure 2-2.

Figure 2-2. Scanner Location in Building 220

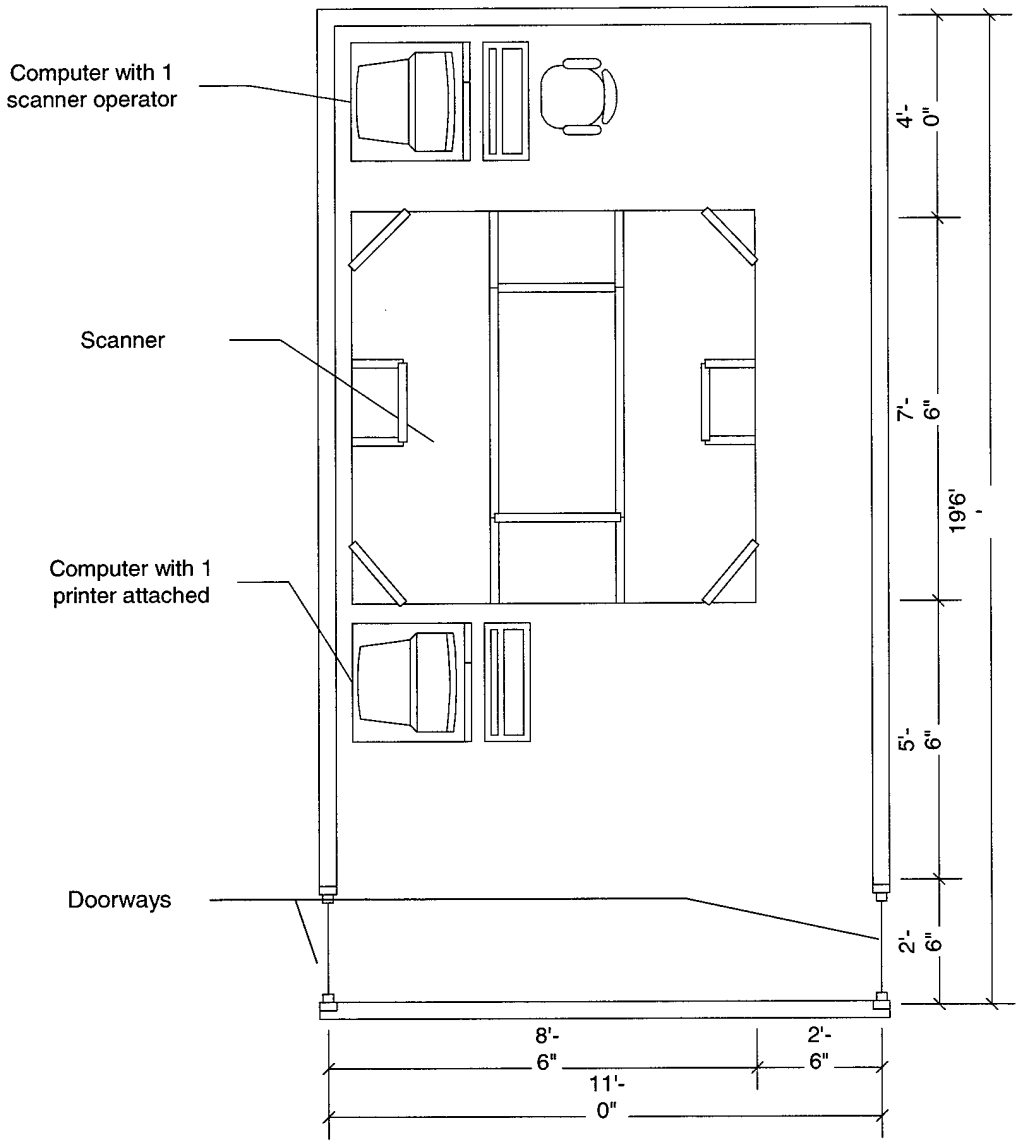


Building 220 contains a small bay with two large bays on both sides. Individual platoons use the large bays for introductory clothing issuance activities and tailoring. The small bay houses an office area and scanner area. The scanner area resides next to a doorway, which allows recruits to move quickly from the scanner to the issue line in Building 221. This scanner placement enables MCRD-SD to incorporate use of the scanner in the clothing issuance process without any costly or time-consuming physical changes to Building 220.

Figure 2-3 shows the five main components of the scanner area. The lengths and widths are approximations to help demonstrate scale. To reduce congestion, separate entrance and exit doorways are located a distance from the scanner operator and in opposite corners. This doorway placement helps to reduce the noise level around the scanner operator. A large black screen encloses the entire scanner area to block stray light from disrupting the scanner's measurements.

The scanner operator station contains a computer and chair. Here a clothing operation employee instructs recruits waiting for scanning, then operates the scanner from the computer. Scanner operation requires input of identification information (recruit's number and roll call), and a click of the scan button on one computer screen. The scanner area includes a printer station so recruits can pick up a printout of scanner-predicted sizes after they have redressed.

Figure 2-3. Scanner Area Layout

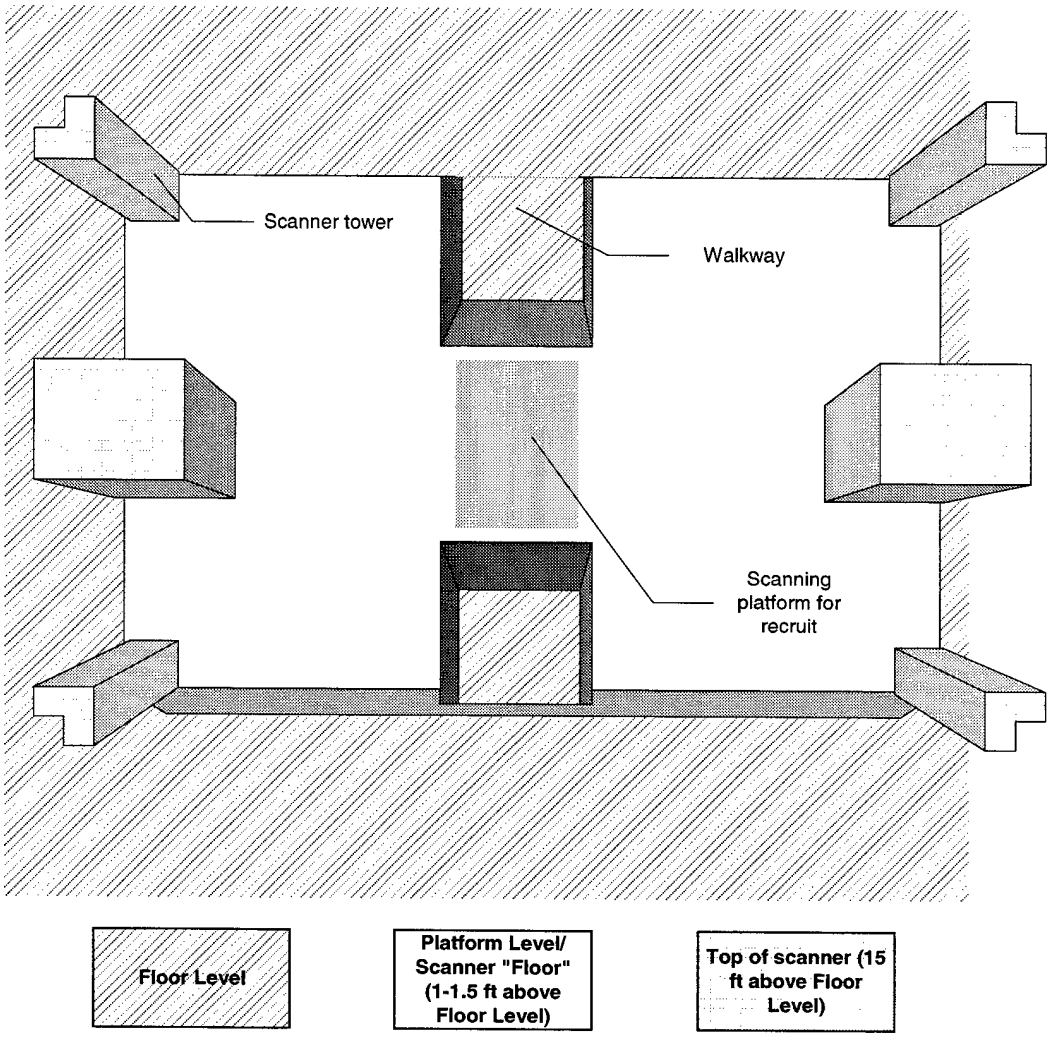


The 3-D scanner itself occupies the largest amount of floor space in the scanner area. The scanner resides in a large black box, the size of a small room, with openings in the middle of two sides. The diagrams that follow show these openings on the North and South side of the scanner. Between these openings runs a walkway at floor level. The remainder of the exposed scanner surface area, or scanner "floor," rests about 1.5 feet above Building 220's floor level. A platform resides in the middle of the walkway. A recruit enters the scanner, steps onto the platform, and positions himself. After the scan, the individual steps off the platform and exits the scanner.

The corners of the scanner box contain mirrors and laser units mounted on towers. The laser projects a light beam as it moves down the tower. When the laser reaches the bottom of the tower, the scan is complete. The laser returns to the top of the tower and waits for computer activation to begin the next scan. The computer reads the light beams and predicts clothing sizes based on algorithms.

Figure 2-4 illustrates an aerial view of the scanner with the black box removed.

Figure 2-4. Aerial View of Scanner



PROCESS FLOW

There are three major activities during a recruit's first fit for dress clothing: measurement/sizing, clothing issue, and alterations/tailoring. MCRD-SD uses the scanner only during measurement/sizing. The training regiment at MCRD-SD allocates 5 hours and 50 minutes (from 0630 to 1220) to complete the clothing activities. This time allotment corresponds to approximately one recruit processed

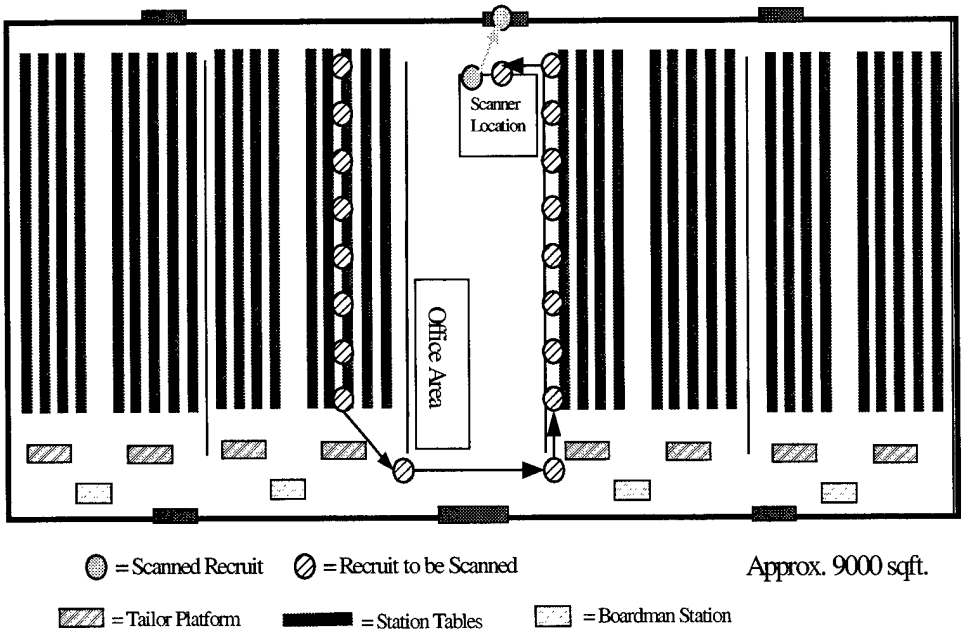
per minute during the peak summer load when MCRD-SD issues clothing to approximately 350 recruits per day.

Four platoons enter the bays in Building 220 at 0630. A clothing operation employee assigns a boardman and bay to each platoon. Boardmen are clothing-operation employees who direct the recruits through the clothing issue process, providing instructions and guidance. The boardman assigned to the work platoon selects 22 recruits to assist in the issue process (19 for the issue line and 3 for the scanner).

The first of the four platoons to arrive at Building 220 receives the first processing. During the instruction period, recruits fill out garment alteration tags (one per recruit), receive a packet of 10 name strips per recruit (returning four name strips per recruit), and listen to a brief explanation of the scanner and issue line. During this time, recruits also remove their clothing except PT shorts, underwear, T-shirt, socks, and sneakers. After the introduction, the platoon leaves its bay and forms a line along a wall outside the scanner area.

While the recruits are in line for the scanner, they remove their PT shorts, T-shirt, socks, and sneakers. Because the instruction period for the first platoon is shortened, scanning of recruits can begin quickly. The first platoon completes its paperwork and tags after passing through the issue line. Figure 2-5 illustrates the movement of recruits from their assigned bay to the scanner.

Figure 2-5. Building 220 Layout and Recruit Movement

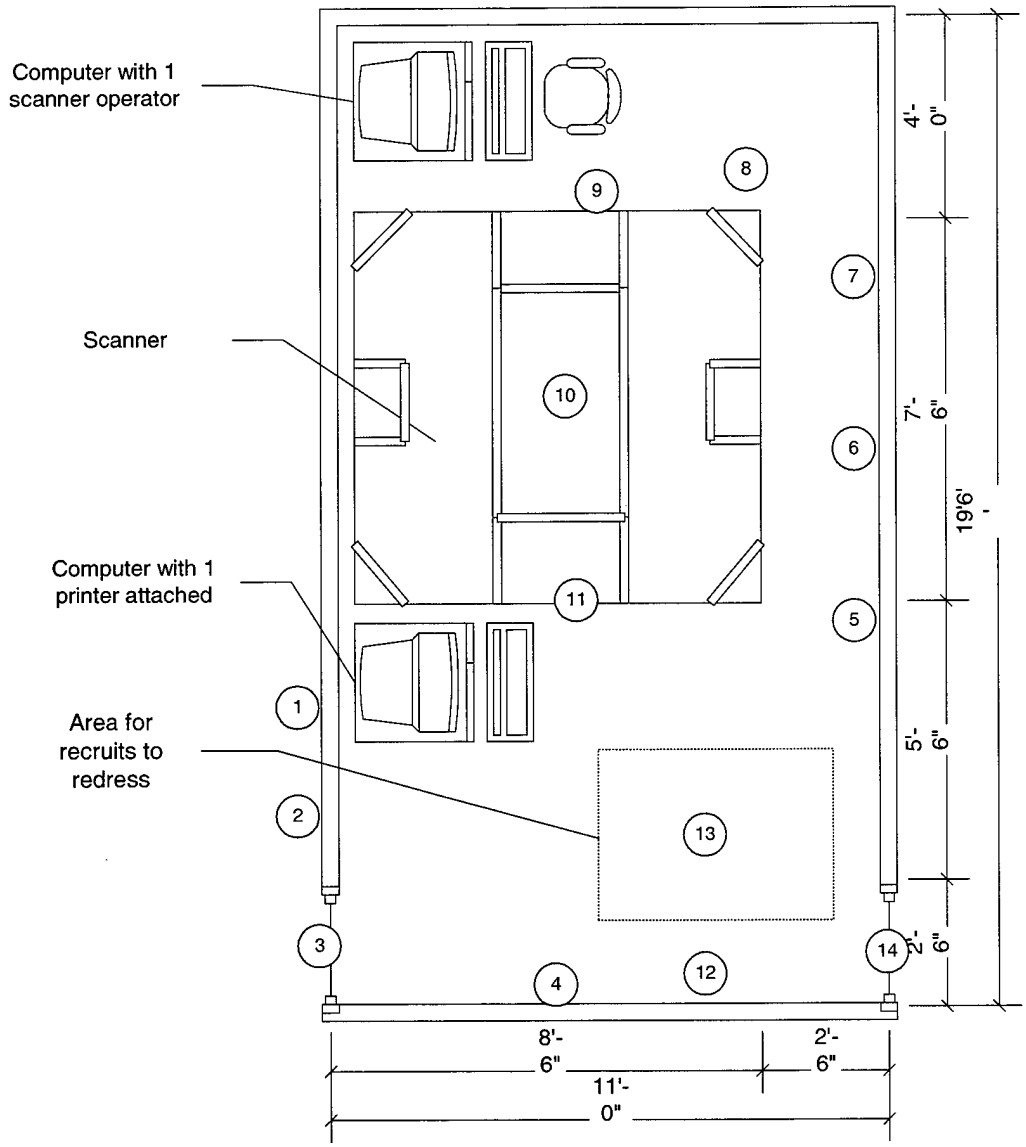


As the remaining three platoons await their turn for scanning, they receive background information and instructions. Platoon scribes complete paperwork and recruits fill out alteration tags. These platoons complete all necessary introductory paperwork and instructions before scanning. The recruits remove all clothing except PT shorts, underwear, T-shirt, socks, and sneakers. When called, each platoon leaves its bay and forms a line along the wall outside the scanner area. As with the first platoon, the recruits in line remove their PT shorts, T-shirt, socks, and sneakers.

Figure 2-6 shows the recruit's movement through the scanner area. The numbered circles in the figure indicate the order of movement. A recruit arrives in line (circle 1) and removes and folds his clothing, except for underwear (circle 2). A recruit worker calls 10 recruits into the scanner area at a time and gives brief instructions for the scanner area. As recruits are called, they enter the scanner area (circle 3), place clothing along a rail (circle 4), look at pictures showing body position during scanning, and get into line (circle 5).

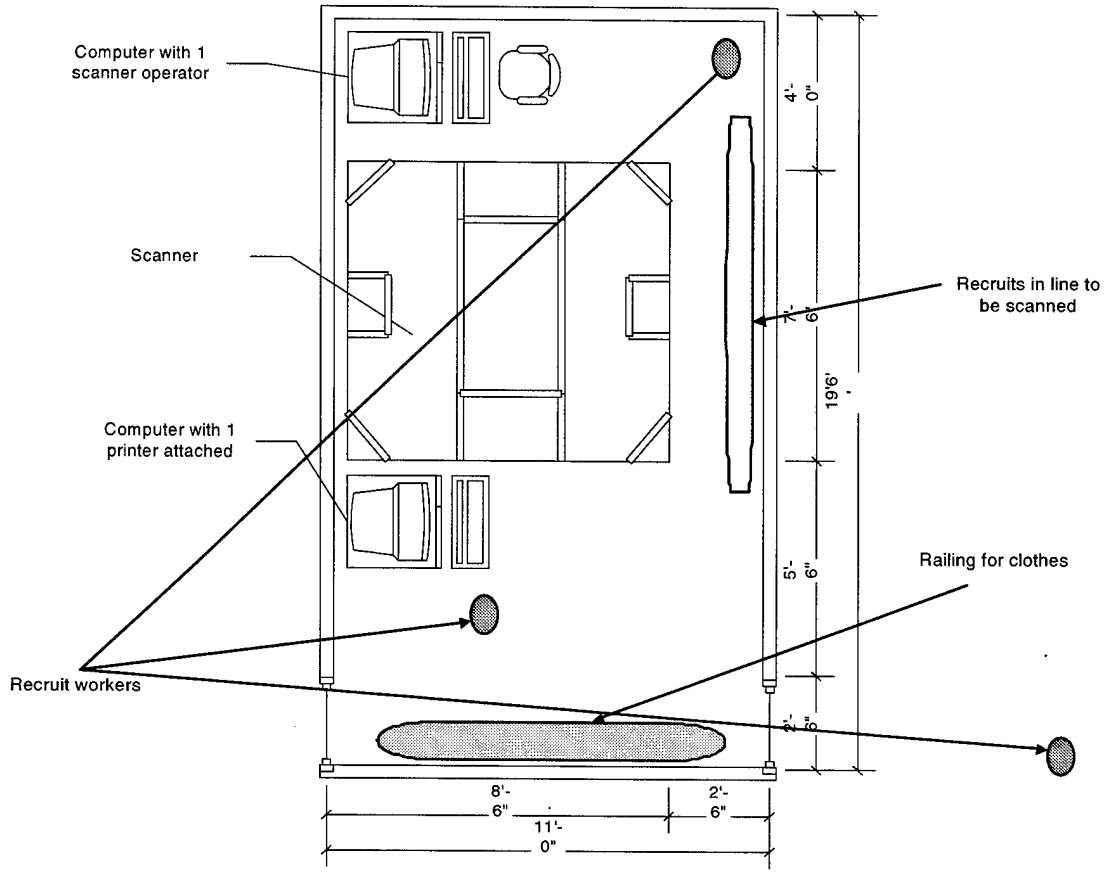
Recruits move up in line as recruits are scanned (circles 6-8), until they are first in line (circle 9). A clothing-operation employee operates the scanner from the computer station located next to circle 9. After each scan finishes, this employee requests the roll call number of the next recruit in line and instructs the recruit to enter the scanner and get into position for scanning (circle 10). While the recruit enters the scanner, the employee enters the recruit's platoon and roll call numbers into the computer. The employee then indicates the start of the scanner and clicks the scan button on the computer. After the scan is complete, the employee says "go" and the recruit steps off the platform and exits the scanner (circle 11).

Figure 2-6. Recruit Movement through the Scanner Area



The recruit worker located near the printer instructs the recruit to return to the rail (circle 12), pick up his clothing, and get dressed (circle 13). As the recruit re-dresses, the computer calculates size predictions and prints a list of the recruit's identification information and predicted sizes. When the list (known as a "chit") prints, a recruit worker hands it to the recruit. Appendix A contains a copy of a chit. The recruit finishes redressing and exits the scanner area (circle 14). From the scanner area, the recruit leaves Building 220 and enters the issue line in Building 221. Figure 2-7 highlights a few of the scanner areas mentioned in the preceding paragraphs.

Figure 2-7. Scanner Area with Highlights



OBSERVATIONS

The scanner can be configured to the needs of the user. MCRD-SD configured its scanner to accommodate the building layout, recruit load, and process flow. The clothing operation serves a large number of recruits (up to 350) at one time. Accordingly, the curtained area encloses a large area enabling the scanner area to hold a relatively large group of people, 15 recruits and 3 workers. The size and shape of the area enclosed by the curtains can change to accommodate different building layouts and recruit loads.

While the scanner box requires only one opening, the second opening in the MCRD-SD scanner allows for a smooth flow of recruits. One recruit exits as another recruit enters. The large openings and the lack of doors enable the next recruits in line to watch the scanner operate. This observation opportunity eases recruits' fears about the scanner and serves as a final reminder of proper body position on the platform.

The printer station can be located anywhere in a clothing issuance process. MCRD-SD located its printer next to the scanner, but in other situations, it could be placed in another position to allow a quick, almost continuous flow of recruits.

The scanner configuration and size can vary to match the user's facilities, clothing issuance process, privacy issues, and recruit load. No configuration is prescribed. To scan recruits properly, the scanner requires only the computer and software, an operator, the scanner hardware, and something to block light.

Chapter 3
Scanner Statistics

During our three visits (February, June, and August 2000) to MCRD-SD, we collected data. We grouped this data into three sections: scan data, critical path, and scan accuracy.

SCAN TIME

This section details the physical process of scanning a recruit. At MCRD-SD, this process involves eight steps:

- Recruit enters the scanner box and positions himself on the scanner platform with chin up, arms and legs spread, and back straight.
- Recruit maintains position during the brief delay before the scanner starts scanning.
- Scanner scans recruit as the lasers travel on their track from the top to the bottom of the scanner towers.
- Recruit steps off the scanner platform and exits the scanner box.
- Lasers move from the bottom of the scanner towers to the top as the scanner returns to "start" position.
- Computer calculates recruit's predicted clothing sizes and prints them on a chit.
- Recruit retrieves clothing and redresses.
- Recruit exits scanner area.

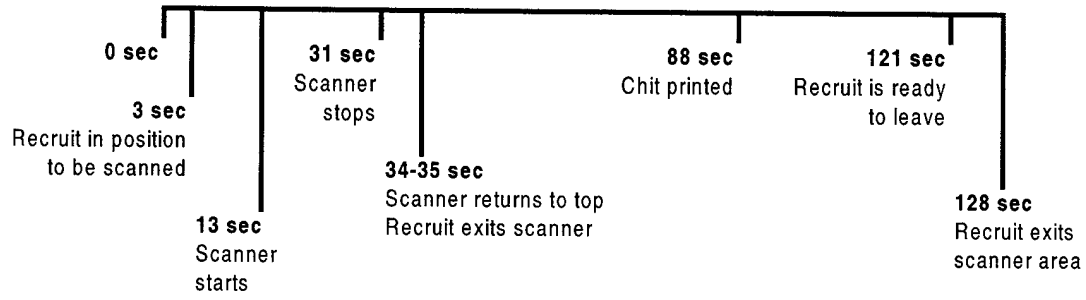
In August 2000, we collected data on the time required to scan 59 recruits. Table 3-1 shows the average times for each of the eight steps.

Table 3-1. Average Scan Times

Scan Step	Average Time
Recruit positions himself on scanner platform	3 sec
Recruit waits for scanner to start	10 sec
Scanner scans recruit	18 sec
Recruit exits scanner	3 sec
Scanner returns to start position	4 sec
Scanner processes scan data and prints chit	58 sec
Recruit redresses	1 min 27 sec
Recruit exits scanner area	6 sec
Average total time	2 min 8 sec

Some of these steps are concurrent. Recruit exiting the scanner and lasers returning to start position occur simultaneously. In addition, the recruit redresses while the scanner processes the data. Figure 3-1 illustrates these steps chronologically.

Figure 3-1. Chronological Scanner Time Data



The figure starts at 0 seconds when the scanner operator requests the recruit's roll call number. At 3 seconds, the recruit finishes getting into position on the scanner platform. At 13 seconds, the lasers begin the scan and start to descend the scanner towers. At 31 seconds, the lasers complete the scan and reach the bottom of the scanner towers. At 34 seconds, the recruit leaves the scanner platform, and at 35 seconds, the lasers return to the top of the scanner towers. At 88 seconds, the software finishes processing the data and prints the recruit's list of predicted clothing sizes. At 121 seconds, the recruit is redressed. At 128 seconds, the recruit leaves the scanner area.

CRITICAL PATH

The data presented in the previous section describes how MCRD-SD uses the scanner; however, the application of scanner technology will vary between user sites. The critical scan path, which is the steps required to properly scan an individual, becomes important to potential user sites.

Use of the scanner requires only five critical steps:

- Recruit positions himself on scanner platform,
- Recruit waits for scanner to start,
- Scanner scans recruit,
- Recruit exits scanner, and
- Scanner returns to start position.

The recruit must position himself on the platform to produce accurate scans and the scanner must scan the recruit to produce the data necessary for size predictions. Also, the lasers must return to the start position before the next recruit can be scanned, and the recruit must exit the scanner to allow the next recruit to position himself on the platform.

It is not a critical step for the recruit to wait for the scanner to start; however, this step allows the scanner operator to look at the recruit and ensure proper positioning. Scanner use at another site might affect this delay and reduce it to 3–4 seconds depending on recruit load, labor resources, and physical layout.

With different process flows, other user sites can eliminate or alter the remaining original steps. For example, conducting clothing issuance activities in only one building might eliminate the need to have the recruits put their shoes back on. This one activity accounted for the majority of the time spent after the recruit left the scanner box. In addition, the chits could print at the start of the issue line. Another possibility is to send the printed list directly to the issue line where clothing in the predicted sizes is loaded directly into a bin that the recruit picks up at the end of the issue line.

Three of the critical steps run concurrently:

- First recruit exits the scanner,
- Lasers return to start position, and
- Next recruit positions himself on the platform.

During the four seconds that it takes for the lasers to return to the start position, one recruit exits the scanner and another recruit positions himself on the platform. The critical path requires 4 seconds for the three concurrent steps, 18 seconds for scanning, and 3–4 seconds for the positioning check. The critical path requires a total of 25–26 seconds per scan.

SCAN ACCURACY

In this section, we show the accuracy of the scanner's ability to predict sizes. We made our observation during our February, June, and August 2000 visits. We tracked size predictions for four garments: dress trousers, dress coat, shirt, and all-weather coat. Table 3-2 shows the data collected on the three visits.

Table 3-2. Scanner Accuracy

Scanner accuracy	February manual (%)	February scanner (%)	June scanner (%)	August scanner (%)
Dress coat	56	55	62	76
Trousers	64	78	83	90
Shirt	50	64	86	93
A/W coat	71	85	86	84

These data are based on 180–244 observations of manual measurements for each garment (depending on garment) in February, 157 observations of scanner measurements in February, 148 observations of scanner measurements in June, and 553 observations of scanner measurements in August. For two visits, the number of all-weather coat observations is lower than the number of observations for the other garments; in February, we observed 17 all-weather coat manual measurements and in June, we observed 51 all-weather coat scanner measurements.

Scanner accuracy increased from February to August for the fit of dress coat, trousers, and shirt. The scanner accuracy represents a marked improvement from hand-measurement accuracy rates. The scanner also produced more accurate size predictions for the all-weather coat; however, for this garment, the scanner appears to have reached a performance plateau. Improvements to the size-prediction algorithms may be needed to increase this accuracy rate.

Chapter 4
Scanner Observations

In this chapter, we present a summery of our observations and suggestions concerning scanner use and layout.

OBSERVATIONS

MCRD-SD's clothing operation staff uses the scanner without difficulty. This reflects both the willingness of the staff to learn and the ease of use of the scanner. Effective scanning requires only a few keystrokes and a check of a recruit's body position. This ease of use enables the clothing operation to switch scanner operators without losing scanner accuracy or efficiency.

Numerous pictures depicting the correct body position during measurement by the scanner hang on the wall in the scanner area. Pictures of correct positioning are useful to teach this task because self-positioning on the scanner platform is not difficult. Pictures provide the instructions more quickly than verbal instructions repeated by clothing issuance workers.

Large scanner box openings allow recruits in line to observe the scanning process of the recruit being scanned. This observation can reinforce the proper body positioning illustrated in the pictures. Some recruits are wary of the scanner because they have heard false stories about things the scanner does to the body. Watching an actual scan seems to reduce those fears.

Often, too many recruits occupy the scanner changing area because of the time required to put on shoes and socks. This delay causes a backup that interferes with incoming recruits who are trying to hang their clothing on the rail and get in line.

During our visits, the scanner experienced little down time; caused mainly by the printer running out of paper and workers disciplining recruits. The scanner's hardware and software remained exceedingly reliable during our three visits.

SUGGESTIONS

Based on our observations, we present four suggestions:

- Scanner use needs to be sufficient to justify cost and produce useful data.
- Scanner area layout can improve the clothing issuance process.

- Potential scanner users should alter clothing issue to provide activities for platoons waiting to be scanned.

- The scanner should be a catalyst for process change.

At MCRD-SD, the scanner operates only 8–12 hours a week; the remainder of the week the scanner sits idle. To attain maximum value of the scanner, additional uses or users (e.g., night issue, multiple fits of the initial dress clothing issue, periodic scanning of the base's population) should be investigated. To address low scanner usage, MCRD-SD initiated discussions about using the scanner at two additional points during the recruit training cycle.

Scanner layout can improve the clothing issuance process. The design of the layout should focus on maximizing the speed of the scanner process while minimizing the negative effects of this speed on scanner accuracy. Two design layout variables that could help achieve these goals are printer location and scanner area size. The printer should be located in an area that reduces the number of recruits lingering in the scanner area, such as at the start of the issue line. The size of the scanner area should reflect the recruit load and physical layout of the facility. Increasing the scanner area increases the scanner area capacity.

Potential users should alter clothing issue to provide activities for the platoons waiting for the scanner. Issuing clothing that does not depend on the size predictions generated by the scanner in this lull could significantly reduce overall issuance time and current bottlenecks. For example, depending on the location and size of the shoe issue station, platoons waiting for the scanner could receive shoe issue. This change in the issue process would require a large shoe station removed from the rest of the issue line. This change might remove one of the largest bottlenecks and longest blocks of time from the issue line.

The introduction of the scanner into the clothing issuance process can serve as a catalyst for examining and changing long-standing processes. The scanner presents an opportunity to redesign the processes to better meet the needs of the Service, recruits, and clothing operations.

Appendix A
Sample Chit

Cyberware
DigiSize

Monday, 07 February, 2000, 20:26:14
DBN: 4071

Rollcall: 003
Platoon: 1111

TROUSERS, MAN'S	31 long
SHIRT, MAN'S	size not found
COAT, MAN'S	39 Long
SWEATER, MAN'S	38
COAT, ALL-WEATHER	40 Long
CAP, GARRISON	6 3/8
FRAME SERVICE CAP	6 3/8
CAP, UTILITY	X - Small
TRUNKS, GENERAL PURP	Small
COAT, CAMOUFLAGE	M / L
TROUSERS, CAMOUFLAGE	M / L

Appendix B
WBX Scanner Specifications Provided by Cyberware as of July 9, 2001

The complete scanner package consists of three main components; scan hardware, scan software, and computers.

WBX Scanner

The scan hardware is optimized for the capture of body surface topology from male or female subjects for the purposes of rapidly obtaining accurate and consistent measurements and performing uniform size selection. The system utilizes harmless red light to create a profile. A sensor captures the profile shape creating an accurate 3D model of the subject. Immediately after the scan, the data is ready for measurement computation and uniform size selection.

Cyberware staff has completed installation of large scanning systems in a diverse set of situations and global locations. Assembly takes roughly two days, but a full week should be allocated to scanner installation, which includes numerous tests and inspections.

Requirements

- Hardware—including scan heads, motion system, scanner enclosure, and cabling
- SCSI or USB connection—connects scan hardware to control and processing computers
- 8' x 8' x 8' (L x W x H) location to house the scan hardware—this is the minimum amount of space required to setup a scanner. Since typical installations include space for an operator, two computers, and subject queuing, dressing, and undressing, scanners require, on average, a 18' x 10' x 8' location.
- Standard office electrical outlets—90-135VAC/175-264VAC, 47-63Hz, and 1500W. The scanner does not require much power and the computer systems can be placed on a separate outlet. Base maintenance or facilities departments can provide information on any special base-imposed power requirements and ensure that outlets are properly rated for the scanner's power requirements. The use of extension cords is not advisable in a permanent installation.

- An office-like environment—an area that is not subject to extremes in temperature, has controlled levels of dust, and some level of controlled access.

- No sources of strong sunlight—sunlight can interfere with the scanning process, so the position of doors and windows will be a factor in selecting the location for the scanner.

Unique Features

- Special clothing for subjects not required
- Used in simple controlled-office lighting environment
- Low sensitivity to subject motion
- No subject preparation prior to scanning
- High-quality data
- Non-contact
- Moving parts completely enclosed
- 8' by 8' Footprint
- Fast and Quiet
- Perfectly aligned scan data
- Extremely reliable
- Real-time data availability

ARNscan Software

The ARNscan software controls the scan hardware and data processing. ARNscan interfaces with the scan hardware, receives and saves scan data, processes measurements, and performs the size selection for US Marine Corps Dress Uniform items. Currently, ARNscan is configured for the issue of male Marines, but the software can be modified to provide size selections for another branch's uniforms or garment items.

Requirements

- Operator—enters subject data, uses ARNscan software to run the scanner, and verifies proper subject position and scan quality
- Size selection tables—convert subject measurements into clothing sizes

Unique Features

- Scan image display
- Simple interface
- Measurements displayed
- Single operator
- Completely automated solution
- Add new garments without additional programming
- Printed size selections

Computing Systems

MCRD-SD's scanner uses two computers. One computer operates the scanner and maintains the file archive, while the other performs measurement computations, makes size selections, and prints issue tickets. One advantage to using two computers lies in the added speed of parallel processing for scanning and processing operations. If speed is not a major concern, one computer can perform both scanning and processing operations.

Requirements

- Two Silicon Graphics computers
- Unix-based hardware and software. A Windows NT version of the ARN-scan software is in development and will be installed and used upon completion.

Capabilities

- Simultaneous scanning and size selection
- Computers optimized for each task

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13. ABSTRACT ***(Maximum 200 words)***

The Marines and the DLA have been working on a series of projects to improve the flow of clothing through the supply chain, reduce inventory, and reduce the number of stockouts and backorders that occur at the recruit centers. One of these projects, funded by the DLA, has been the development of a 3-D body scanner to replace hand measurement. With the 3-D scanner ready for prove-out, MCRD-SD agreed to use the scanner on a trial basis.

During the field trial, DLA asked LMI to assess the physical set-up and performance of the scanner at MCRD-SD. We observed that the scanner experienced little down time and the clothing operation staff at MCRD-SD uses the scanner without difficulty. We suggest that scanner use needs to be sufficient to justify cost and produce useful data. The introduction of the scanner into clothing issuance can serve as a catalyst for examining and changing long-standing processes. The scanner presents an opportunity to redesign these processes to better meet the needs of the Service, recruits, and clothing operations.

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